REMARKS

Claims 1 through 25 are pending in the instant patent application. Claims 1, 11, 21 and 22 through newly added Claim 25 are the independent claims. Claims 2 through 10 depend from Claim 1. Claims 12 through 20 depend from independent Claim 11.

The Office has indicated that Claims 6, and 16 are objected to as being dependent on a rejected base claim but would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. The Office has further indicated that independent Claims 22 through 24 are allowed.

Applicants express appreciation of the indication and allowance of Claims 6, 16, and 22 through 24. Applicants note that the Office has indicated that none of the cited references disclose or suggest a computer-implemented method for modeling a non-linear empirical process that uses a log of a hyperbolic cosine function. Applicants respectfully contend that the above Claims are allowable for this reason, the reasons set forth in the patent application as originally filed and for the reasons set forth in the replies filed during the prosecution of the patent application. Applicants respectfully acknowledge the allowable subject matter indicated for Claims 6 and 16 and the allowance of Claims 22 through 24.

Applicants have added new independent Claim 25. New independent Claim 25 recites that, "the global behavior [is] at least in regions of sparse initial input <u>or in regions of missing initial input</u>." Emphasis added. Support for this amendment can be found in the patent application as originally filed at page 15, line 25. No new matter is added. Entry of the amendment is respectfully requested.

In the previous Office Action, Claims 1 through 5, 7 through 15 and 17 through 21 were rejected under 35 U.S.C. § 102 as being anticipated by *Lightbody* (IEEE article, published March 21-24, 1994). Applicants successfully traversed that rejection. Turning to the final Office

Action at hand, the Claims have been rejected primarily by United States Patent No. 5,877,954 to Klimasauskas, *et al,* which is a new ground for rejection. However, although the Office has entered a new ground for rejection, the Office has made the new rejection final. M.P.E.P. § 706.07(a) clearly provides that, "under present practice, second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims nor based on information submitted in an information disclosure statement filed during the period set forth in 37 C.F.R. §1.97(c) with the fee set forth in 37 C.F.R. §1.17(p)". Emphasis added.

Applicants contend that the final rejection is premature, and since the Office introduces a new ground of rejection, the instant office action should be a non-final rejection, not a final office action, and the Applicants should be afforded an opportunity to respond to the rejection and amend the claims without the Office issuing an advisory action indicating that such an amendment would raise new issues that require additional consideration and/or search. Applicants respectfully request that the Office withdraw the finality of the rejection at hand, and consider the amendment.

By way of background, the present disclosure relates to a computer-implemented method for modeling a non-linear empirical process. The method includes creating an initial model generally corresponding to the non-linear empirical process to be modeled with the initial model having a base non-linear function, an initial input and an initial output.

The computer-implemented method includes constructing a non-linear network model based on the initial model. The non-linear network model has (a) multiple inputs based on the initial input and (b) a global behavior for the non-linear network model as a whole that conforms generally to the initial output.

The global behavior is at least in regions of sparse initial input. Turning to Applicants' specification page 15, line 25, the invention provides a reliable global behavior, such as

increasing monotonicity, in regions of missing or sparse model input data 28 that can be used in the training stage 104.

The method also has the step of calibrating the non-linear network model based on empirical inputs by using a bound on an analytical derivative of the base non-linear function that allows global properties such as the global minimum and maximum values of the analytical derivatives to be calculated directly from model coefficients that can be used to produce, via a constrained nonlinear optimization method, an analytically constrained model with global behavior. Emphasis added. The analytically constrained model provides precision control of the non-linear empirical process. Emphasis supplied.

In the Action, Claims 1 through 5, 7 through 15 and 17 through 21 are rejected under 35 U.S.C. § 102(b) as being anticipated by United States Patent No. 5,877,954 to Klimasauskas, *et al.* (hereinafter "Klimasauskas"). Applicants traverse the rejection by stating that commonly owned Klimasauskas does not disclose or suggest all of the elements of Claim 1.

Klimasauskas discloses a neural network for modeling a process. The process has one or more disturbance variables as process input conditions, one or more corresponding manipulated variables as process control conditions, and one or more corresponding controlled variables as process output conditions.

The apparatus includes a data derived primary analyzer 132. See Column 7, lines 46 through 57. The primary analyzer 132 is adapted to sample an input vector spanning one or more of the disturbance variables and manipulated variables. The primary analyzer 132 generates an output based on the input vector.

The Klimasauskas neural network includes a derivative calculator for computing a derivative of the output of the primary analyzer and an integrator coupled to the output of the derivative calculator for generating a predicted value. The neural network also includes a hybrid analyzer 122 with an error correction analyzer 131 (See Column 8, line 9) that is adapted to

sample the input vector with the error correction analyzer 131 and estimate a residual between the data derived primary analyzer output and the controlled variables.

The neural network also includes an adder module 134 that is coupled to the output of the data derived primary analyzer 132 and the error correction analyzer 131. See Column 8, lines 21 through 25. The adder module 134 sums the output of the primary and error correction analyzers to estimate the controlled variables.

In this manner, the system can predict the difference between the primary model predictions and the target variables. The outputs are obtained by running the primary model over <u>all</u> available data and calculating the difference between <u>the outputs</u> of the primary model and the target variables for <u>each</u> data point using the neural network training processes. Emphasis added. The neural network can thus learn how to <u>bias</u> the model for producing more accurate predictions. See Column 12, line 60 through Column 13, line 13.

However, Applicants contend that Klimasauskas does not disclose or suggest that the non-linear network model has (a) multiple inputs based on the initial input and (b) a global behavior for the non-linear network model as a whole that conforms generally to the initial output where the <u>global behavior is at least in regions of sparse initial input</u>.

Moreover, Applicants contend that Klimasauskas does not disclose or suggest calibrating the non-linear network model based on empirical inputs by using a bound on an analytical derivative of the base non-linear function that allows global properties such as the global minimum and maximum values of the analytical derivatives <u>to be calculated directly from model coefficients</u> that can be used to produce, via a constrained nonlinear optimization method, <u>an analytically constrained model with global behavior</u>. Emphasis added.

Applicants contend that Klimasauskas discloses a hybrid linear-neural network which uses a fixed linear model in areas of interpolation and uses a fixed linear model in areas of extrapolation in order to protect against spurious behaviour of the hybrid linear-neural network.

This means that Klimasauskas' model converges to the same linear model regardless of the point of extrapolation, and Klimasauskas' model does not produce the analytically constrained model of Claim 1 of the present invention.

The nature of extrapolation of Klimasauskas is therefore arbitrary. The present invention does not supplement a base model with a linear model in order to protect against spurious model behavior. In contrast, the present invention model of Claim 1 is superior and is advantageous since it is a continuous nonlinear model that can have different extrapolative behaviour that is dependent on the point of extrapolation. This is particularly advantageous over areas of sparse or missing data.

The nature of the extrapolation is therefore closely linked to the behavior of the model at the point of extrapolation. The Klimasauskas model is calibrated purely on the basis of minimum error criteria on both a training data set and testing dataset. No penalties are applied during model calibration for violating analytical constraints imposed on the analytical model derivatives.

The calibration method does not have to be a constrained nonlinear optimization method. The present disclosure inherently requires that the model calibration algorithm respect the analytical constraints imposed on the analytical model derivatives (that can be calculated directly from the model coefficients). This approach essentially guarantees that the model derivatives will be within specified minimum and maximum limits from an analytical perspective as claimed in Claim 1. A constrained nonlinear optimization method is typically essential for model calibration.

The Klimasauskas model is a hybrid model that includes a linear model and a nonlinear model. Claim 1 does not necessarily represent a hybrid model. It is a single model that is fully continuous and fully differentiable. The Klimasauskas model uses an unconstrained neural network. This underlying model can behave counter-intuitively in regions of extrapolation and sparse interpolation, or in regions of missing data. The model of Claim 1 is advantageous since that the model is analytically constrained to guarantee specific input/output behavior globally.

Klimasauskas discloses that the system can predict the difference between the primary model predictions and the target variables with the outputs being obtained by running the primary model over all available data regions and calculating the difference between the outputs of the primary model and the target variables for each data point using the neural network training processes. See Column 12, line 60 through Column 13, line 13.

Applicants contend that conventional neural networks do not perform predictably in areas of missing or sparse model input data 28, while the present invention does indeed perform well, and provides reliable global behavior in such areas. Thus, Klimasauskas does not anticipate the claimed invention of base Claim 1. Applicants believe that Claims 11 and 21 are patentable for reasons similar to those argued above for Claim 1.

Claims 2 through 5 and 7 through 10 depend from Claim 1, and Claims 12 through 15 and 17 through 20 depend from Claim 11. Thus these claims are patentable for at least the reasons discussed above for the base claims from which they depend. As such the 35 U.S.C § 102 (b) rejections of Claims 1 through 5, 7 through 15 and 17 through 21 are believed to be overcome and should be withdrawn. Reconsideration and withdrawal of the rejection are earnestly solicited.

Applicants further contend that newly added independent Claim 25 is also patentable. Applicants submit that none of the references alone or in combination with one another disclose or suggest a method of constructing a non-linear network model based on the initial model with the non-linear network model having (a) multiple inputs based on the initial input and (b) a

global behavior for the non-linear network model as a whole that conforms generally to the initial output with the global behavior being at least in regions of sparse initial input or in regions of missing initial input. Emphasis added. Allowance of Claim 25 is requested.

Information Disclosure Statement

A Supplemental Information Disclosure Statement (SIDS) is being filed concurrently herewith. Entry and consideration of the IDS is respectfully requested.]

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims (*e.g.*, Claims 1 through 25) are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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